Development Of Didactical Design Of Mathematics Pedagogy Through Professional Program Of Mathematics Teacher Education

Turmudi, Yaya S. Kusumah, Dadang Juandi, and Endang Mulyana
Department of Mathematics Education, Indonesia University of Education
email : turmudi_ah@yahoo.com; turmudi@upi.edu

Abstract: This paper discusses about developing model of didactical design on mathematical pedagogy in the area of mathematics. Subject matter proficiency and didactical pedagogy competences of teachers were not mutually exclusive, so the specific studies on how to teach mathematics that anticipate the combination of both subject and pedagogical knowledges, called Mathematical pedagogy (Backer, 1991), need to be conducted. In designing model that can change the participants to become professional mathematics teachers, a didactical design was used as a framework. Further step, the didactical triangle by Kanasen (2003) was used as a guideline by integrating didactical-pedagogical anticipation. How was the step of metapedadidactic, the context of mathematical pedagogy, and how to develop an appropriate design for developing didactical design model in the study of educational program for develop professional teacher education program (PTEP) or Pendidikan Profesi Guru (PPG) of mathematics, later on will be called PTEP. The product of this study is theoretical and empirical models in *didactical pedagogical design* based on the subject of mathematical pedagogy.

Key words: mathematical pedagogy, didactical design, teacher profession

Abstrak: Artikel ini membicarakan pengembangan model desain didaktis dalam pedagogi matematis. Mahir dalam matematika dan dalam kompetensi pedagogi matematis tidak saling lepas, sehingga penelitian yang khusus pada bagaimana mengajarkan matematika yang mengantisipasi kombinasi antara penguasaan matematika dan penguasaan pedagogi matematis dinamakan pedagigy matematis (Backer, 1991), perlu dilakukan. Untuk mendesain model yang dapat mengubah para peserta pendidikan profesi guru menjadi guru matematika yang profesional, digunakan framework desain didaktis. Lebih lanjut, segitiga didaktis dari Kanasen (2003) digunakan sebagai petunjuk dengan cara mengintegrasikan pengertian antisipasi didaktis pedagogis. Bagaimana tahapan dari *metapedadidactic* dalam konteks matematika pedagogis, dan bagaimana mengembangkan desain yang sesuai untuk pengembangan model desain didaktis dalam program pendidikan profesi guru matematika dilakukan. Hasil dari penelitian ini adalah model teoritis dan empiris dari *didactical pedagogical design* berdasarkan (subject specific pedagogy in mathematics) atau pedagogi matematis.

Kata Kunci: matematika pedagogis, desain didaktis, profesi guru

To be a professional mathematics teacher, it is not sufficient for someone who is expert in mathematics, without the knowledge on how to present the concepts in mathematics. According to National Council of Teachers of Mathematics (NCTM, 2000), "Effective teaching requires knowing and understanding mathematics and students as learners," (p.17). So, other skills, including pedagogical knowledge and mathematical content knowledge, are required to be mastered by a mathematics teacher who would like to become more professional. In this case, Backer (1991) considered it as a subject-specific pedagogy, if working in mathematis area, then would be call mathematical pedagogy. It is recognized that in the era of information and globalization, the teacher's knowledge is becoming complex and dynamic (Fennema & Franke, 1992). New aspects of learning such as mastering computer technology by the teachers is a crucial aspect. However, the balance of the content and pedagogical knowledge of mathematics which refer to pedagogical content knowledge (Shulman, 1987; Pinar, Reynolds, Slattery & Taubman, 1995; Holmes, 2009) should be the most important component in the area of mathematics teacher's knowledge and skills. Mathematical pedagogy refers to how to teach mathematical

contents, and how to understand the students' way of thinking, including the consideration of the cultural background of students, and the diversity of teachers' teaching styles.

Nowadays, qualification of a mathematics teacher in Indonesia must be a graduate of S1 or D4 (equivalent to bachelor degree) with an additional teaching certificate. To obtain a teaching certificate, a professional teacher candidate needs to take one of the mechanisms, such as portfolios program, or portfolios equipped with PLPG (short program for Professional Teacher Education and Training), or by joining the professional teacher education program (PTEP).

In the previous kinds of mathematics teacher education system, the courses of mathematics subject and pedagogy were given separately. The students of mathematics teachers training program should be a master in the field of mathematics. Moreover, she or he also has to master teaching strategies in mathematics, in the curriculum development, in evaluating student learning as well as mastering teaching media. According to Brodjonegoro (2003), most teacher education programs (of mathematics) have been conducted in concurrent models, which means that both teaching subject matter (mathematics) and teaching strategies are given in the same package program. For example, the curriculum structure of prospective mathematics teachers (Gaffar, 2004) covers the subject matter: algebra, geometry, statistics, topology, calculus, and computing, while pedagogical knowledge they could take includes: methods of teaching, educational research, evaluation in education, general knowledge (includes religious education, moral education, the environment and citizenship, as well as educational psychology and educational administration)(Gaffar, 2004).

Since the decree of Regulation of Teachers and Lecturers of the 2005, the Government Regulation (Peraturan Pemerintah) No. 74, (2008) stipulated that a teacher requires an academic qualification of S1 or D4, have to have teaching certificate, physically and mentally healthy, and are able to achieve national education goals (PP 74, 2008, Pasal 2).

Professional Teacher Education (PTEP) is the spirit of professionalization of educators, which must be marked with a unique service recognized by public and the government, have relatively long education process, supervised training in the process of teaching practice (PPL) by applying the tips and contextual non-routine under scrutiny professionals, as well as proper remuneration followed by continuous professional development responsibilities (Kartadinata, 2010, iii).

Professional Teacher Education Program (PTEP) both in-service teachers and pre-service teacher position until now does not have any model that can be used as guidelines. However, the Directorate of Higher Education Ministry of Education and Culture has held several workshops in conducting PTEP (in Jakarta, Solo, Yogyakarta, Bali, Surabaya, and in some other places), but the models are still being developed, guidelines are strictly followed by the organizers of Professional Teacher Education program (PTEP).

Professional and pedagogical competence cannot be taught in isolation based upon each scientific tradition. Rather, it must be developed in a package that combines the two aspects. Backer (1991) introduced the term mathematical pedagogy. According to Backer (1991), "Mathematical pedagogy represents current efforts to integrate the learning of contents with the learning of pedagogy-a goal that has eluded attracted teacher and educator for more than a century" (p.2). How to combine mathematics subjects with pedagogical subjects became a target of educational experts in the United States since that time and in the context of the development of Professional Teacher Education in Indonesia it is to be one of the alternatives that can be adapted.

The diagram of the article cited in An, showed that content knowledge alone is not sufficient for a good professional teacher. It is true that a deep understanding of mathematics was a very important element for the teachers, but it turns out that the understanding of the content alone is not sufficient to be able to teach mathematics effectively. They proposed that in addition to mastery of mathematics, a teacher should have a deep understanding of mathematics, and knowledge of the curriculum and the learning that they recognize as profound pedagogical content knowledge.

Issues of current mathematics learning has become a subject of discussion for teachers. The research results by Turmudi (2006) showed that mathematics teachers in Bandung has innovative insights in the study of mathematics, but honestly admit they have not been able to apply the learning of mathematics with the current teaching, which are considered as innovative approaches.

Situations that still decorate the teachers in the teaching activities as disclosed by Turmudi & Juandi (2010), and Turmudi, Juandi, Wihatma,& Harningsih

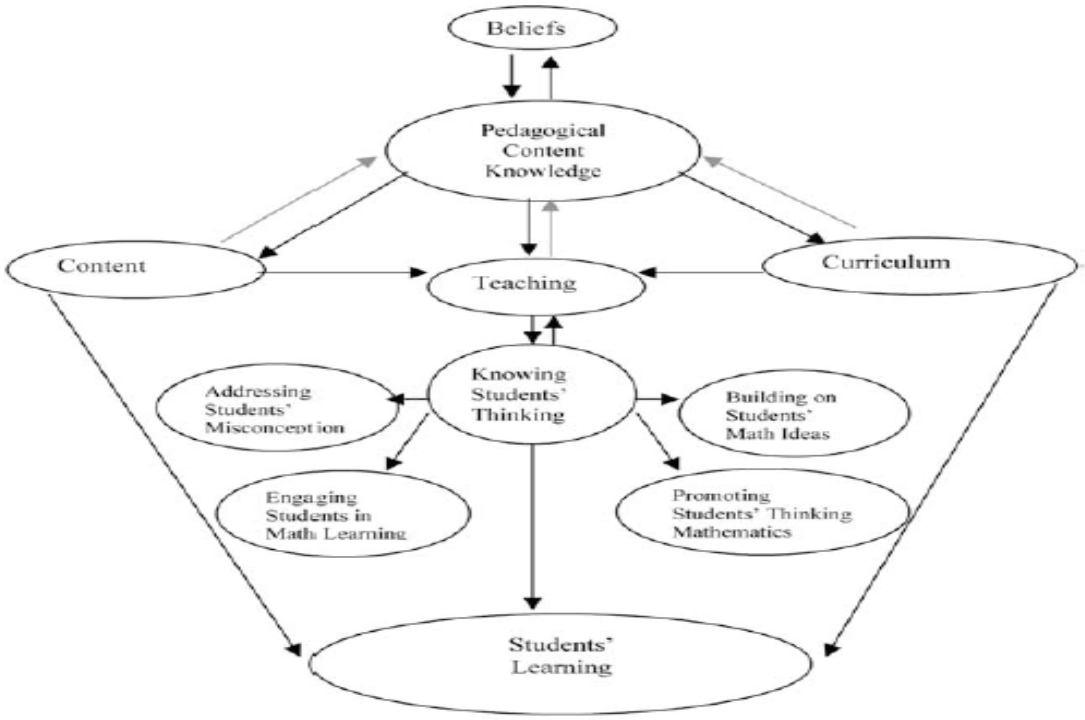

Figure 1: Network of PCK adapted from An, Kulm, & Wu (2004)

(2010) when the instructor asked the teachers at professional development workshops in the event of PLPG: "Are you, as a mathematics teacher who should teach mathematics, providing enough space for students to develop a creative thinking?"Most of the teachers argued that they could not provide opportunity for students to make them creative because of the limited time and the curriculum is so rigorous targets, and that they have prepare national standardized tests/examinations. Therefore,it was natural when the teaching expository method was to be the teacher's choice. Method of expositoryin mathematics teaching stated by Wahyudin (1999) as "a favourite choice of teachers in learning mathematics".

The study raised the issue of designing of the didactic pedagogy of Brousseau (cited in Suryadi, 2005) combined with the idea of mathematics Mathematical pedagogy (CTPA, 2008; Backer, 1991). Professional teacher education program participants were expected to have experience in designing teaching materials and are able to teach the students at school with a touch of didactical design and Mathematical pedagogy. Contemporary issues concerning the implementation of learning mathematics has been introduced to the participants, i.e. the current models and approaches to learning mathematics, especially in empowering students to be able to construct knowledge independently. In this case, a teacher who is able to facilitate the students' learning process is needed. The questions for the purpose of this study are (1) Could the PTEP participants involved in developing mathematical pedagogic of didactical design teach mathematics better? (2) By using Didactical Design of Mathematical pedagogy(DDSSP), can the participants of PTEP facilitate students to construct mathematical knowledge?

Theoretical Framework

Professional competence of teachers are being the main target of Teacher Education. Therefore, the government's efforts to improve the professional qualifications of prospective teachers become a necessity (Roberts & Pruitt, 2009). Teacher education institution has an obligation to produce prospective teachers with sufficient knowledge and skills in mathematics. Inequipping a number of knowledge and skills of teachers, CTPA (2008) introduced the concept of subject-specific pedagogy as combining both subject matter of mathematics and pedagogical subjects. Adequate mastery of mathematics only is not enough for a teacher to be able to present a coherent

teaching mathematics to the students at school, because it could happen that the structure of the subject matter they presented not in accordance with the child's developmental level. Conversely, when the mastery of strategies and teaching methods are adequate, but not adequately mastering the subject matter is also not enough to be a good teacher who has a pedagogical and professional competence. Therefore both mastery and ingenuity in presenting two capabilities, namely the ability of mathematics subject and pedagogical subject skills should manifest themselves in a teacher.

The problem is how to provide experiences for the teachers to be able to teach students through subject-specific pedagogy (Backer, 1991) and about the formation of students' mental object to be studied in depth by the theory of didactic situations (Brousseau in Suryadi, 2005). According to the theory of didactic situations (Brousseau, 1997), a teacher in the learning process will create a situation that could become the starting point of the learning process. Furthermore Suryadi (2005) offers a model of triangular metapedadidactic as modification of the model described by Brousseau. Student-Teacher-Subject relationship was depicted by Kanasen (in Suryadi, 2008) as a didactic triangle that describes the didactic-relationship (DR) the relationship between the subject matter and the students, and the pedagogical relationship (PR) between teachers and students.

Figure 2: The Triangle of Didactical Pedagogy (Suryadi, 2005)

The triangular model does not connect the teacher to the material. Therefore, Suryadi (2008) proposes to complete the other side of the relationship between the teacher and material that was called anticipation of didactic and pedagogic (ADP) relations. The main role of the teacher in the context of the didactic triangle is creating a didactic situation that occurs in the student learning process. It can be interpreted that a teacher is not only master in teaching materials, but also need to have knowledge related to students, as well as able to create a situation that could encourage didactical learning process optimally. This was called a didactical relation (Suryadi, 2005), the relationship between students and teaching materials. The complexity of learning activities, so that in introducing the concepts to the student, an inspiring teacher of mathematics does not only master the subject matter, but also develop ability to look at an important thing comprehensively, identifying, and analyzing important issues, and perform actions precisely so as to create an optimal learning situation. Capabilities that need to be owned by teachers was called metapedadidactic (Suryadi, 2005).

By having the skills of metapedadidactic, a teacher should be: (1) able to look at the components of the modified triangle of didactic ADP, PR, and DR as an inseparable unity, (2) able to act so as to create a situation to develop didactic and pedagogical situations corresponding needs, (3) be able to identify and analyze student responses as a result of actions didactic and pedagogical actions that are performed, (4) able to perform actions based on advanced didactic and pedagogical response analysis of students towards the achievement of the learning targets.

The purpose of this study is to develop didactical design of mathematical pedagogy. Didactic design model is expected to be a reference and guidance in implementing the Professional Teacher Education Program (PTEP) in Mathematics Education Study Program in particular, and the implementation of PTEP at Indonesia University of Education in general. In line with a good learning process and activities that should be done in good learning environment, Crowther, Ferguson, & Hann (2008) said "Good teaching and learning involves a variety of new and exciting ideas for classroom activities. Where possible, activities should be hands-on, creative, and set in different environments. At the beginning of a unit, students should set goals to be accomplished by the end of that unit. Where possible, students should be given choices, because everyone had different interests and learning abilities. Students need to be respected and treated as individuals ".

According to the California Teaching Performance Assessment – CTPA (2008) there are six aspects discussed in the mathematical pedagogy:

(1) to make students understand mathematics, (2) to assess student learning, (3) to engage and encourage students to learn mathematics, (4) to plan and design learning experiences student learning, (5) to create and maintain effective environments for student learning, and (6) the develop professional educators. These six aspects will be described in the following sections.

Making Mathematics comprehensible by Students

In order to understand mathematics, prospective teachers should have sufficient knowledge to be able to build mathematical concepts that students would build at school. In addition, teachers are also expected to analyze the materials of the school mathematics curriculum. Not only can mention curriculum structure as proposed and adopted by our government, which in this case is the structure of the school mathematics curriculum (BSNP, 2006), a professional teacher candidate is also required to be able to master the principles, facts, concepts, procedures, rules of mathematics, theorems, definition, as well as the properties of numbers, measurement and geometry, space and spatial, algebra, statistics and chance, calculus, trigonometry, as well as vector. Beside for himself, a prospective teacher should be able to teach students, how to take control, and master how to teach students related to mathematical knowledge pedagogically (Roberts &Pruitt: 2009).

Mastery of mathematics for themselves categorized as master of subject matter. Good in mastery of mathematics has a greater opportunity to be able to properly convey mathematics subject for the students. Delivering material to students means how the teacher can help students to comprehend mathematical concepts (making subject matter comprehensible to student). To meet these criteria of prospective professional teachers, one should understand the mathematics curriculum adopted by the government, understand how to teach, plan lessons that meet the mathematics standards, and demonstrate how to teach mathematics using standards which in accordance with a pre-determined plan. In the theory of Didactical Design Research (DDR) how students understand mathematical concepts and how students should interact with teaching materials known as didactic relationship (Suryadi, 2005).

In recognizing didactic relationship, a professional teacher should introduce mathematical concepts by using context. Through the context, the students understand the content, structure, and properties of mathematics that are encased in the context. So, the teacher should master mathematical concepts pursued through mathematization process, in which the students understand the concepts gradually. In relation to the teachers of PPG participants, they discuss mathematical material that is packaged in the subject specific pedagogy (SSP) in this case mathematical pedagogy workshop.

According to Suryadi (2008) the main role of the teacher in the context of the didactic triangle is creating a didactic situation so that a process of learning took place within the students. It means that a teacher needs to master the concept of mathematics besides teaching, she/he also needs to have knowledge related to students as well as to create a situation that could encourage didactic learning process optimally. In other words, a teacher needs to have an ability to create didactical relationships between students and teaching materials in order to create an ideal didactic situation for students. In this situation during the mathematical pedagogy workshop, the participants are engaged in efforts to create a didactic situation. What kind of teaching materials that can be used as a discussion so that students at the school are involved in understanding the concepts, principles, and procedures in mathematics.The planting phase of the pedagogical skills of the students participating in PTEP begins with workshop materials related to the content standards in the school mathematics curriculum. After understanding mathematical concepts: principles, theories, procedures, definitions, and mathematical concepts, they formulate lesson plans that will be implemented in a real classroom. But they piloted the plan in the context of the classroom peer teaching, a class that students (member of class) are their peers or friends who also sailed together in mathematics class of PTEP. Model of mathematical pedagogy workshop is a consequence of Act No. 14 of 2005, the content standar (SI) of mathematics curriculum (BSNP, 2006) and Decree No. 41, about the Process Standard of 2007, and Decree No. 16 of 2007, about Competency Standard for the Teacher.

Assessing Student-Monitor students during the learning process.

To monitor student learning during the learning process in a "peer teaching" model teacher pursued through two stages. The first stage is to monitor the students' ability to understand mathematical concepts,

whether the 'pupil' in peer teaching understand the material presented. The procedure adopted during the learning process if the students have to master concepts, procedures, theorems, and mathematical properties presented by the teacher. The teacher monitors 'students' understanding. Based on the monitoring results of the teacher, if students do not understand the concept of targeted learning, then the teacher has an obligation to repeat it so that students come to understand, the teacher has an obligation to look for other alternatives to cultivate understanding of mathematical concepts at the time.

Involving and Supporting Student Learning

Making the mathematics curriculum comprehensible and mastered by students is an obligation of a teacher. Content standards are the minimum standards that should be presented to students. In other words, the scope of which has been summarized in the outlined curriculum content standards, while the depth of students' understanding of mathematics concepts which were outlined in the teachers' lesson plans are equipped with media, teaching materials, and assessment plan that teachers do. The teacher encourages students to understand mathematical concepts that are given by using a multi-strategies, multi-activities, and various learning resources. Students are facilitated by the teacher sufficiently, so that learning takes place in an optimal condition.The teacher should sort and prioritize materials which will be presented first and the material that will be presented later, so that students will more easily be able to organize mathematics materials.

Activity learning experiences for the students is an activity that encourages students, not only wish but also keen to do so. Therefore, the formulation of learning objectives academically should be known by 'students'. What is to be achieved in studying the activity need to be provided to the students. The teacher needs to convince students to participate actively and assured equal rights in learning mathematics. This is the importance of teachers to constantly monitor students 'progress', and have an obligation to extend students' thinking in the

study of concepts, principles, and ideas of mathematics.

Related to the stages and levels of student thinking, teachers should enable student to learn mathematical concepts appropriate to developmental level of the students. For junior high school students, teachers should provide learning experiences that appropriate with the level of their thinking development. Games and puzzles are still favored by students of junior high school. Therefore, it is advisable to present the context of the teacher through a game or a puzzle.

The teaching materials and interesting mathematics learning media are still a hope to help instill learners understanding of mathematical concepts, as basically the students of junior high school are in the level of concrete thinking and the transition between the concrete and the abstract levels. So, the use of media or teaching materials was so significant for the continuity of the educational mathematics learning. Although the high school and vocational school students have come to a more abstract stage, it would be a need for high school students also to learn how to use the media and manipulative teaching materials. For example, for the solid geometry, students need assistance for representing models of objects and the three-dimensional objects using frame models.

Formulation of the Pythagorean theorem, for example, students should discover, not through information submitted by teachers, but through investigation and exploration of the students pursued. In terms of how teachers providing instructional materials thus, driven by a principle of the proposed didactical triangle of Brouseau (1997) and refined by Suryadi (2008), namely the principle of ADP (anticipation didactic, pedagogical). In practice the adjustment of learning to the curriculum, Brousseau (1997) introduces a didactic situation which includes students, teachers, curriculum content, class work ethic, as well as social and institutional measures, including government directives such as curriculum standards, supervisors and examiners of the inspectorate, or pressure from the group of the parents.

In the didactic situation, Brousseau identifies implicit context to be a didactic contract between the teacher and the student. The contract is "Teacher must teach and students are required to learn (Brousseau & Otte, 1991, p. 18), or at least the students pass the test. Teacher design learning tasks for students, and students perform tasks designed by the teacher that the contract is working on learning tasks, the students will be able to pass from the test. According to Brousseau & Otte (1991: 180) this contract must be paid, and the cost, if not then there will be no education, if not adhered to then the contract should be canceled, because knowledge can not be transmitted, and therefore no one both teacher and

students who can be commanded.

Learning to plan and Designing Student's Learning Experiences

In a learning plan that begins with an analysis of the curriculum, a teacher can identify the students in advance, and pay attention to the students consider the overall strategy will be used, the media and what manipulative materials were used for learning, and what was the appropriate tool for the evaluation of class particular in learning. What kind of learning experience designed by the teachers, so that students have ready knowledge, knowledge that has been asked of the students, provide feedback in the form of a question of challenging problems for students. The teacher also reveals the purpose to be achieved by students, which is already provided by the standard of competence and basic competences in mathematics curriculum content standards. Therefore, teachers can reduce the indicators of Competency Standards (CS) and the Basic Competency (BC) that were given. By using CS/BC and derived indicators, teacher outlines a learning experience that students will experience. The teacher outlines scenarios and sequence for student learning. With the given scenario of teachers, students try to build mathematical understanding through the process of understanding the concepts, principles, formulas, procedures, algorithms, definitions, and properties in mathematics.

Flow path or understanding or learning trajectory (Simon, 1995; Simon & Tzur, 2004) can be selected by the students, for example for the problems that are open-ended, or problem-based learning, or mathematical modeling. Students can take the path desired understanding, but the target is the understanding of mathematical concepts that become the target of the current study.

Figure 3: The students of Junior Secondary School in Learning Mathematics

Allocation and Timing of Social and Environmental Settings

Allocation of study time is usually set together when determining the academic calendar, but how to estimate the time required in the learning of mathematics, a teacher can determine how many CS/BC and how many indicators that can be developed to divide the available time for learning mathematics. It is necessary to estimate how much time it takes allocation reached in this way, but for experienced teachers, they usually distribute their time very tightly. Although the strategy has been set at the beginning, usually students have the freedom to determine final responsibility of a learning process. Setting conducive social environment in the classroom, teachers can arrange individualized learning, learning is done by group work or work in pair. It is intended that the ability of the group needs to be established in order to build a larger national framework. The existence of the nation started with the establishment of the work-collaboratively in small groups to join, and the ability to work in small group to materialize when individuals become reality. In other words the ability to solve national problems begins with the ability to work in small groups. These small groups are conducive to materialize when the individual is also able to work well. The role of individuals in the group work can be as initiators, as a buffer, or the registrar, as contributors, as a commentator, or as an explanatory answer to obscurity.

Professional Development for Educators

In the professional duties of a teacher, it can be started from the responsible teacher candidates in understand mathematical concepts. A prospective teacher has the responsibility for student success in the future. Therefore prospective teachers are being trained to become professional teachers in charge constantly to monitor students' progress. He/she has a professional obligation to always master the concepts, principles, procedures, definitions, theorems, and the like. He always tries to update with follow-scientific workshops, seminars, or professional activities of teachers. He is always learns how to use a computer (ICT), both knowledge and skill in the computer, or/ and internet learning.

In addition to the mastery of professional competence, a professional teacher is also required to master the pedagogical competence. Teachers

always look for the most effective strategies in teaching mathematics and seek diversity strategies and learning approaches. These are also the hallmark of a professional teacher. This kind of teacher does not give up easily with difficult circumstances and challenging problems. Teaching methods are innovative, creative and targeted professional teachers to reach them. They have never got tired and given up the professional activities of teachers to improve their teaching skills. He is always 'hungry' for the knowledge and has a high desire to always succeed in mathematics learning in the classroom.

Research Methods

This study is part of a study of the development of model of mathematical pedagogy workshop (MPW or as Backer called as subject specific pedagogy) which includes the development of teaching materials, models of learning activities, and assessment workshop models, and models of PTEP competency test for teachers' professional competence grow. Actually, overall the study includes two phases, each phase will be implemented in one year, but in practice each period can be made into one semester. This followed a series of research methods development research (developmental research) through thought experiments and instruction experiments performed cyclically (Freudenthal, 1991) and concludes with experimental studies for validation purposes mathematics pedagogy workshop models are developed. Cummulatively, the development process was shown in the following diagram.

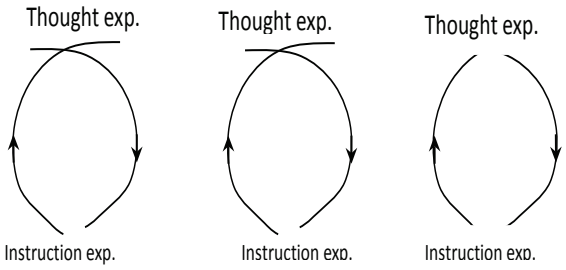

Figure 4: Cyclic of Developmental Research (Freudenthal, 1991)

The research was conducted in two stages: (1) the first step in the Department of Mathematics Education of UPI, with subject of PTEP participants, guardian teachers, and PTEP lecturers. (2) The second phase is done in several schools in the city, with the main subject of junior high school students, high school, vocational school, and guardian teachers.

Figure 5: A Group of Participants (Peer Teaching)

Necessary data in this study have been be collected through a number ways in which the study documentation, and video camera, observation learning, filling the questionnaire, interview and written test (professional competence test of future teachers, and achievement test of students who study as a participant of PTEP) were used.

Written Test for PPG participants and Written test for Students

Written test mastery of mathematics schools and pedagogical content knowledge were intended to determine the extent to which the participants of PTEP master in school mathematics and teaching methodologies (pedagogical and didactical) mathematics. It was a requirement that needed to be known by PTEP participants to enable them to meet standard of professional competence and pedagogical competence (Act No. 14 of 2005, on Teachers and Lecturers). Descriptive data were analyzed qualitatively by describing each step to be taken: The first stage: the identification and development blueprint of the mathematical pedagogy workshop models which include the development of models of teaching materials, the model of workshops, as well as test models and competency assessment process, with the following steps: (1) analyze theoretically the professional development of teachers, (2) identify

the characteristics of the model of mathematical pedagogy workshop for teachers' professional development skills, (3) identify the issues of relevant field, and (4) develop a prototype model of workshop of teaching materials, workshop models, and models of assessment processes and teacher competencies. Having obtained a prototype model of didactic and pedagogical workshops, teachers will require: (1) analysis of the theoretical models of teaching materials, workshop models, assessment models, as well as instruments to measure teachers' professional competence, (2) improvement of the model workshop for teaching materials, workshop models, and models assessment.

The second stage: the model refinement workshop, in addition to a thorough evaluation of all components of developed models. Model refinement and evaluation activities are focused to reveal the effectiveness of all components of the developed workshop and to uncover the main characteristics of the model workshop that develops the potential of teachers' professional competence, responsiveness and performance of participants. It also reveals the PPG program as a result of the developed workshop models, and to uncover the basic principles that guarantee the implementation of learning quality in improving the professional competence of teachers. In connection to these matters, the last stage was done with the aim of (1) seeing the effectiveness of the model developed for PTEP participants to become professional teachers; (2) seeing the effectiveness of the model developed for professional upgrading of teachers (teacher tutors); (3) evaluating the workshop models, models of teaching materials and assessment models, and (4) disseminating through scientific activities such as seminars/ workshops and publications.

Discussion

In the PTEP held by The Departement of Mathematics Education, the participants were required to analyze the current mathematics curriculum. With regard to the Competence Standard and Basic Competence of Content Standard, the participants try to understand the mathematics section by section. According to the perceptions of the participants, how the level of mastery of Content Standard follows the description illustrates the competence of PTEP.

A total of 79% of participants can be categorized as appropriate and understand the Content Standard in the Mathematics Curriculum, as much as 79% of participants claimed to understand how to teach the subject matter, 79% of participants stated could create lesson plans appropriate with the plan, and 8% participants, stated very suitable according to the standards, as well as 75% of students felt able to demonstrate the ability to teach according to standards. In general, the participants perceived that they were able to understand the standard of school curriculum, understand how to teach it, able to plan according to the standard and be able to demonstrate their teaching ability in the classroom.

Recognition of the participants by the guardian teacher and lecturers show that though the participants are not excellent, generally they understand the material according to the Standard and they can demonstrate the learning of mathematics. As for some people who seem to still put in a neutral position, they can be interpreted as not fully mastered the material in learning. To meet the expected criteria, a professional teacher candidate should understand the mathematics curriculum adopted by the government, to understand how to teach mathematics in the curriculum standards, able to plan lessons that meet the mathematics standards, and be able to demonstrate how to teach mathematics standards and in accordance with the plan established. In terms of processing of mathematical knowledge as asked in a test, the participant was able to complete could be considered as one of the tasks assigned curriculum.

Workshop Model of Mathematical pedagogy

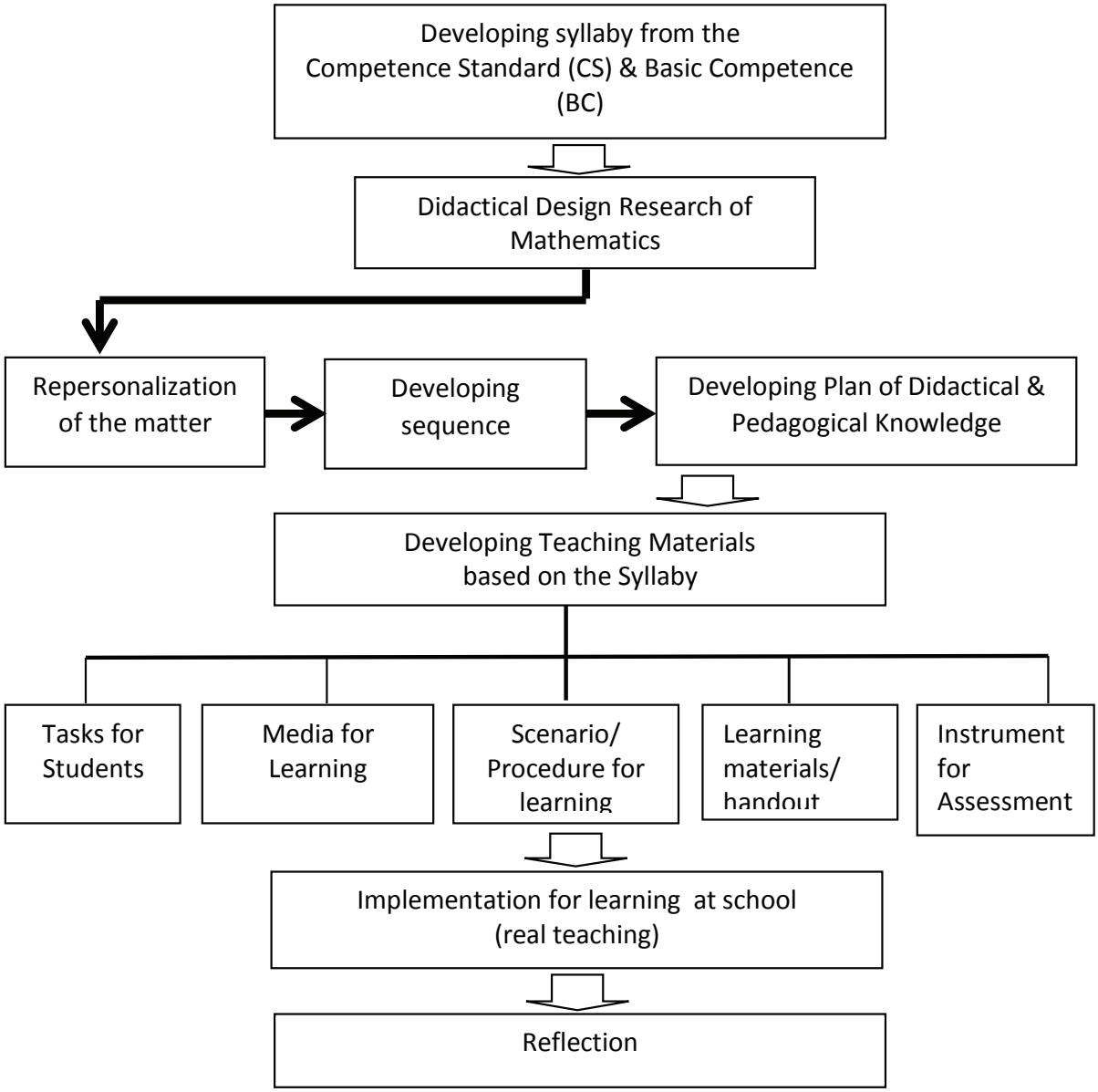

Figure 6: Model of Mathematical Pedagogy (Revision)

The following question has been responded by a praticipant in thier own procedure:

How to get the length of AD if the length of AB is 12 cm, BC = 9 cm and CD = 9 cm?

One of the PTEP participants gives answers as shown in the Figure below.

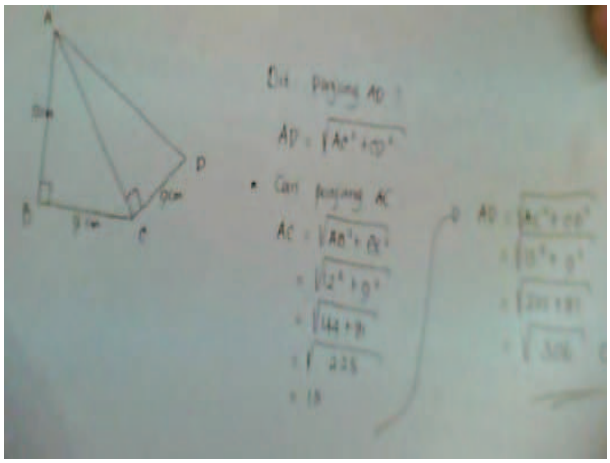

Figure 7: The Sample of a Participant's Work

The main role of the teacher in the context of the didactic triangle is creating a didactical situation, so that a process of learning of the students was taking please. The ability of prospective teachers in one of the examples above could be teachers equip them according to the criteria, however, prospective teachers who have mastered these new requirements need to be a teacher, pedagogical mastery was needed to become a teacher.

Based on the implementation of mathematical pedagogy workshop with the above model, which includes the five stages of the findings obtained as follows. At this stage of development of syllabus: (1) PTEP participants lack the essential idea of the material depicted in defining indicators oflearning; (2) The difficulty of PTEP participants that PPG was in collating sequence indicators of process-products.

In the development phase of lesson plan and completeness: (1) PTEP participants still have a lack of proper understanding of the various concepts of mathematics (language conflict), particularly with regard to the geometry materials; (2) The difficulty of PTEP participants was in communicating concepts and principles appropriately, both in statements explicitly or implicitly; (3) The participants of PTEP have difficulty in developing alternatives of ordering material presentation; (4) The PTEP participants have difficulty to list the students tasks hierarchially; (5) The PTEP participants so stricly tied to the students textbooks in developing teaching materials and tools/media for learning; (6) Learning approach that selected by participants, in general, is student-centered approach, but the processes of learning activities written in in the lesson plan were less detailed.

In order to mathematics designed was comprehensible by the students, the efforts made by the participants of PTEP were to design lesson plan which appropriate with the learning standards of mathematics, as well as demonstrate the learning in the classroom. Outlines of learning ability in SPP workshop illustrated that participants of PTEP are less have an idea of the essential material that reflected in determining of learning indicators. To overcome this situation, the participants obtained input from the observer, in this case from the supervisor and the guardian teachers. Inputs obtained by the participants was used to improve the design of their lesson plan. Such as the difficulty in setting indicators of mastery learning materials, students practice in making operational sentences, so that students could 'digest' what the teacher did, so student's actions could be measured to see their successful. Indicators that have been formulated, encourages the PTEP participants have the desire to implement their lesson plans in the classroom, although at first time they were just trying to apply it in peer teaching setting, teaching their fellow of PTEP participants with mathematics instructional materials that have been designed previously. However, the participants of PTEP teaching practice in peer teaching also gain valuable input from faculty mentors and guardian teachers. These improvements are recorded to revise the design and plans implemented in a real learning during teaching practice (PTEP) at the school.

The participants demonstrate their ability in real teaching of mathematics to students at schools, attended by supervisors and guardian teachers, until the guardian teacher and supervisor claim that the participants were capable of making mathematics understandable by the students. Situations during a peer teaching was initially considered severe enough by the PTEP participants. This is because they were not used to speaking in front of friends, the supervisors, or the guardian teachers. But it turns out that heavy feeling experienced only at the beginning of it. Because for the second, third, fourth and so on, were not perceived as a heavy burden for the PTEP participants.

Assessing Students-Monitor Students during the Learning Process

To monitor the students during the learning process to be conducted in the "peer teaching", model teacher pursued through two stages. The first stage was to monitor the students' ability to understand mathematical concepts, whether the 'pupil' in peer teaching understand mathematics concepts presented by model teacher. This procedure was adopted during the learning process if the students had to master in concepts, procedures, theorems, and mathematical properties presented by the model teacher. The teacher monitor student understanding, but the problem happening was that the "students" referred to in the context of peer teaching were their own friends, the PTEP participants, for example that the students who have graduated of mathematics bachelor degree level, making it difficult to measure whether the 'students' already know or' students' have not mastered yet the concepts and mathematical knowledge. For example if they have already

known because of learning or because of previouse knowledge they have. Nevertheless, peer teaching has become a forum that could be used by PTEP participants to practice their teaching, a practice to enable students to learn mathematics.

The situation is similar to the actual learning of mathematics, which acts as learners or students are the ones who have a grasp of mathematical concepts. Therefore the students in the "peer teaching" class did not seem to face "learning obstacles". Did this really seem like the truth remains to be tested.

The second stage, apart from having to monitor the students' understanding of the process was continuously in the class, the PTEP participants role models as teachers should always use instructional strategies and techniques to support the 'students' learning of mathematics. This was so that students always facilitated by teachers to understand mathematical concepts. Maybe students could read the contextual problem which given by the teachers. With that context students may be able to formulate a conjecture related to the structured context, and questions that were formulated. Furthermore students could collect data or information or evidence to test the truth of the conjecture that students made. Data were generated from the context given to a student, the student's task here was to dig and carry out exploration and investigation of phenomenon presented by mathematics teacher. According to didactic-relations (DR) point of view, including how students explore and investigate of mathematical problem presentation given by the teacher. Students are also required to interpret the mathematical representation given by other students. Students' comments with respect to the interpretation of mathematical ideas appear as the effects of didactic relationship. Teachers should be able to bring up the possibility of the creation of didactic situations.

The teacher needs to master the material they teach, and also need to have knowledge related to students as well as to create a situation that could encourage didactic learning process optimally. In other words, a teacher needs to have the ability to create didactical relationship between students and teaching materials in order to create an ideal of didactical situation for students.

Self Assessment

To find out what was felt when creating lesson plans and teaching aids, objectively the participants expressed his weaknesses, as well as efforts to improve themselves in the next stages. For example, the participant who served in one of the Junior High School in Bandung,admitted that after finishing the implementation of peer teaching, Mirza (not real name) argued:

> For the broad topic area of the circle, in the first lesson plan: (1) the indicator should the students have come to determine the formula for area of a circle, (2) on the worksheet, students should construct their own sectors into a shape similar to a rectangle, (3) on the worksheet too many pictures that did not need to be. In second lesson plan he felt, (1) on the power point display he felt too much animation, (2) the division of the board that are less effective, in the 3rd lesson plan, Mirza say (1) that he did not give a chance to the students to write the conclusion in board, (2) triangular images on exercises less bulky, so when in the paste on the board could not be clearly looked from behind class.

After teaching Peer Amy (not real name) suggests the following self-assessment

> (1) the application of the natural day-to-day life has not been right, have not mastered the material preconditions of linear equations and inequalities of one variable, (3) lack of master classes in another lesson plan, Amy argues that (1) the use of teaching aid less appropriate yet, (2) has not been summarizes the properties of cubes and blocks, (3) lack of enthusiasm and lack of master classes. (4) less rigorous in correcting students' answers are presented.

A prospective teacher (ALJ), who practicedat a junior secondary school, after peer teaching with the 4th lesson plan argues:

> (1) there is still a sense of doubt, fear, and stage fright, (2) the use of media are still not optimal. ALJ who practice in the field experience of SMP 29, when completed training in peer teaching argues (1) the concept of set has not been mastered, so has not finished yet, (2) insufficient time and less energic (3) did not master the mathematical concepts, the used of teaching media is not visible, does not mastery of his classes.

That's the general idea PTEP participants as they practice in the use of peer teaching setting with the peers (friends own) as students.

Conclusions and Recommendations

There are two fundamental conclusions of this study the results of which would be measured by the results of theoretical and empirical studies.

1. Theoretically professional teachers were expected to have the ability to build didactical relationships, the ability to establish pedagogical relationships, and the ability to anticipate the didactic pedagogical relationship.
2. Empirically PTEP participating students have abilities above and have been applied in stages mathematical pedagogy, although there were still some weaknesses.

In addition to the above conclusion, the participants also have the mathematical ability (a didactic relationship), though still less than satisfactory, they have the ability to process mathematical understandable (comprehensible) by students. In the pedagogical aspects, the participants were able to design materials with lesson plans and syllaby by anticipating aspects of character education.

Of the six aspects outlined in the development of mathematical pedagogy, students make mathematics understandable. PTEP participants were able to make mathematics understandable to students. This was done by understanding the mathematics curriculum content standards, by understanding how to teach the subject matter using standards, making plan the lessons according to the standard, as well as having ability to demonstrate their teaching according to standards.

The participants of PTEP also were able to assess the learning done in class, able to monitor the progress of students understanding of mathematical concepts using standards, capable in using strategies and techniques to support students' learning. However, students were still not able to understand the meaning of assessment, less able to interpret the results of assessment, as well as less able to interpret assessment feedback in learning mathematics.

The PTEP participants were able to engage and encourage students to study mathematics, able to earn the mathematics curriculum content standards, able to select and use a variety of instructional strategies of mathematics, understand academic goals, were able to convince the involvement of students, were able to monitor the students' progress, however they were less able to prioritize curriculum content. The participants were able to plan learning mathematics and designing learning experiences of students, by focusing on the psychological development of students, and understand how students learn to anticipate them using appropriate learning approach. Setting goals as outlined in the learning plan implemented in the classroom by linking the curriculum materials and background students' ability to anticipate the strategies and activities selected.

The participants were not optimally create an effective learning environment for students. The participants have difficulty to make a social interaction with the people at schools. Professional indicator, that PTEP participants have responsibility for student success, have a professional obligation and ethical duty, knowing the obligation to obey the rules. In the teaching practice (PPL) of professional teacher, the PTEP participants evaluated teaching practices and students' knowledge of the subject matter, as well as reflection and feedback to improve learning in the classroom.

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